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PTSD and Substance-Related Problems: The Mediating Roles of Disconstraint and Negative Emotionality

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The authors examined competing hypotheses regarding the role of 2 personality dimensions, disconstraint and negative emotionality, in mediating the relationship between posttraumatic stress disorder (PTSD) severity and substance-related problems. Data were drawn from a large sample of male Vietnam veterans. The best-fitting structural model included significant indirect paths from PTSD to both alcohol- and drug-related outcomes through disconstraint, and a significant indirect path from PTSD to alcohol-related problems through negative emotionality. There were no direct effects of PTSD on either substance-related outcome. These findings indicate distinct pathways to different forms of substance-related problems in PTSD and underscore the role of personality in mediating these relationships.

Keywords: disconstraint, posttraumatic stress disorder, negative emotionality, substance use, alcohol use

Posttraumatic stress disorder (PTSD) is an extreme psychobiological reaction to a traumatic event defined by a constellation of 17 symptoms that reflect profound disturbances in cognitive, affective, behavioral, and physiological functioning. PTSD shows a severe and diverse pattern of diagnostic comorbidity (T. A. Brown, Campbell, Lehman, Grisham, & Mancill, 2001) with frequently co-occurring conditions ranging from the internalizing spectrum (e.g., the unipolar mood and anxiety disorders) to the externalizing spectrum (e.g., antisociality and substance abuse; cf. Krueger, 1999; Krueger, McGue, & Iacono, 2001). Understanding the basis of this comorbidity is important to the advancement and refinement of clinical, etiological, and nosological conceptualizations of posttraumatic psychopathology. Toward this end, we used structural equation modeling to examine hypothesized mechanisms for the association between PTSD and substance-related problems using data drawn from a large sample of male veterans with histories of traumatic combat exposure.

Substance use disorders are among the most common comorbidities in individuals with PTSD, occurring in an estimated 50–85% of those with the disorder (Keane & Wolfe, 1990; Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995; Kulka et al., 1990). The predominant explanation for this association—the PTSD self-medication hypothesis—asserts that individuals with PTSD use substances in an effort to reduce or control distress-related symptoms, and this behavior is maintained by negative reinforcement resulting from symptom relief (P. J. Brown & Wolfe, 1994; Stewart, 1996). Support for this hypothesis comes from studies showing that the severity of substance abuse is positively correlated with PTSD severity (P. J. Brown, Sout, & Gannon-Rowley, 1998; McFall, Mackay, & Donovan, 1992; Stewart, Conrod, Pihl, & Doniger, 1999) and evidence that when the conditions co-occur PTSD tends to predate the substance abuse (Kessler, 2000; Kessler et al., 1995; Najavits, Weiss, & Shaw, 1999).

The PTSD self-medication hypothesis is consistent with a wider body of addictions research implicating heightened negative emotionality (Krueger, Caspi, Moffitt, Silva, & McGee, 1996; McGue, Slutske, & Iacono, 1999; Myers, Aarons, Tomlinson, & Stein, 2003) and negative reinforcement (Baker, Piper, Fiore, McCarthy, & Majeskie, 2004) in the etiology and maintenance of substance use disorders. Specifically, this literature suggests that substance use is associated with efforts to reduce negative emotionality. This perspective is consonant with Cloninger's (1987) observation that many alcoholics (termed Type I) drink primarily to reduce anxiety and distress, as well as with evidence that substance-related disorders occur at high rates in other anxiety and unipolar mood disorders (T. A. Brown et al., 2001; Grant et al., 2004). Research has not yet addressed whether the association between PTSD and substance-related problems is specific to PTSD symptomatology, a consequence of the more generalized heightened negative emotionality that accompanies PTSD and all of the distress disorders (Clark & Watson, 1991; Clark, Watson, & Mineka, 1994; Miller, 2003; Watson & Clark, 1984), or both?

The personality dimension disconstraint is another important factor in the etiology of addictive behavior that has received little attention to date in the literature on comorbid PTSD and substance use disorder. This characteristic relates to individual differences in disinhibition or behavioral undercontrol (i.e., sensation seeking, impulsivity, low constraint) and is associated with earlier onset, heavier consumption, and greater persistence of alcohol use and abuse

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(Bennett, McCrady, Johnson, & Pandina, 1999; Chassin, Pitts, & Prost, 2002; Hill, White, Chung, Hawkins, & Catalano, 2000; Jackson, Sher, & Wood, 2000). Disconstraint is also an established cross-sectional correlate and a prospective predictor of substance use and substance-related disorders (Caspi, Moffitt, Newman, & Silva, 1996; Cloninger, Sigvardsson, & Bohman, 1988; Krueger et al., 1996; Massee & Tremblay, 1997; McGue et al., 1999).

If disconstraint is a mediator between PTSD and substance abuse, then PTSD should also be related to disconstraint. Indeed, evidence suggests that individuals with PTSD score higher on measures of disconstraint (Kuhne, Orr, & Baraga, 1993; Miller, Greif, & Smith, 2003), sensation seeking (Wilson, Smith, & Johnson, 1985) and novelty seeking (Richman & Frueh, 1997; Wang, Mason, Charney, & Yehuda, 1997) than comparison participants without the disorder. Disconstraint is also predictive of comorbid substance-related disorders in men and women with a predominantly externalizing form of posttraumatic psychopathology (Miller et al., 2003; Miller, Kaloupek, Dillon, & Keane, 2004; Miller & Resick, in press). These individuals exhibit many of the characteristics of Cloninger's (1987) Type II alcoholics: They tend to be sensation seeking, fearless, prone to engage in risky and/or uninhibited behavior, use substances because they enjoy the states of disinhibition that they produce, and are prone to antisocial behavior. To account for this association, Miller (2003) hypothesized that PTSD compromises self-regulatory processes resulting in an accentuation of pathogenic traits, including disconstraint, relative to premorbid levels.

The primary aim of this study was to use structural equation modeling to examine, for the first time, the relative contributions of the personality dimensions disconstraint and negative emotionality to the relationship between PTSD severity and substance-related problems. Data for secondary analysis were drawn from a large sample of male Vietnam veterans who participated in a Department of Veterans Affairs (VA) multisite cooperative study of PTSD (Keane et al., 1998). Disconstraint and negative emotionality were indexed by the *Personality Psychopathology Five Scales for the MMPI–2* (PSY–5; Harkness, McNulty, & Ben-Porath, 1995; Harkness, McNulty, Ben-Porath, & Graham, 2002). The PSY–5 Disconstraint scale reflects Tellegen's (1985, in press) conceptualization of the construct as involving tendencies toward physical risk-taking, a self-regulatory style characterized more by impulsivity than control, and attitudes that are unbounded by traditional moral constraints. The PSY–5 Negative Emotionality scale, on the other hand, taps a broad affective disposition to experience negative emotional states, especially anxiety, anger, worry, and regret. This construct is ubiquitous in the study of personality and psychopathology, closely aligned with neuroticism (Costa & McCrae, 1985; Eysenck & Eysenck, 1975), and reflects an essential dimension of psychological distress. Negative emotionality has also been conceptualized as both a risk factor in the development of PTSD, and a dimension of personality that may become accentuated as a consequence of the development of PTSD (Miller, 2003, 2004).[1]

Study Hypotheses

The foregoing literature review suggests a complex array of possible associations between PTSD, personality, and substance-related problems. In this study we tested the following competing hypotheses:

1. If individuals with PTSD use substances to alleviate their symptoms (i.e., the PTSD symptom self-medication hypothesis), then we should expect to find significant direct paths from PTSD severity to the outcome variables alcohol and drug problems.

2. If the personality dimensions disconstraint and negative emotionality fully mediate the association between PTSD and substance-related outcomes, then we should observe significant indirect paths from PTSD to these outcomes through the personality factors, but no direct paths from PTSD to the outcome variables. The disconstraint and negative emotionality pathways represent conceptually distinct mechanisms for the PTSD–substance use association, the former implicating problems in the domain of impulse control, the latter representing a variant of the PTSD self-medication hypothesis. Evidence in support of this hypothesis would imply that after controlling for the influence of these personality factors, the specific *DSM* symptoms of PTSD account for an insignificant proportion of variance in co-occurring substance-related problems.

3. If disconstraint and negative emotionality only partially mediate the association between PTSD and substance problems, then we should expect to observe both direct paths from PTSD to substance use and significant indirect paths from PTSD to substance use through these personality factors.

Method

Participants

Participants were male military veterans who served in the Vietnam theater of operations between August 1964 and May 1975 and were using health services of the VA at the time of study enrollment. Recruitment took place over a 42-month interval between 1989 and 1992 from inpatient and outpatient programs at 15 VA medical centers across the United States. As the focus of the original study was on the psychophysiological assessment of PTSD, individuals were excluded from participation if they (a) were taking medications that might have significantly altered their autonomic responding, (b) had any medical condition that would influence psycho-

[1] Although there is considerable overlap between the constructs negative emotionality and PTSD (as is the case with all of the distress disorders; Watson, Gamez, & Simms, 2005), there are also important phenomenological and conceptual distinctions to be drawn between the two. Whereas the first represents a personality trait that is generally assumed to be relatively stable over time (Costa & McCrae, 1977, 1992; Watson & Walker, 1996), the second is a constellation of psychiatric symptoms that develops in response to a specific event (and, by definition, was not evident prior to it). At the item level, measures of these two constructs show minimal explicit criterion contamination (Anastasi, 1988). The PSY–5 Negative Emotionality scale is composed primarily of items assessing the tendency to experience feelings of worry, regret, nervousness/anxiety, fear, and anger. The only area of obvious overlap with PTSD, as defined by the 17 *DSM–IV* symptoms, is in the domain of anger/irritability. The PSY–5 scale includes no representation of the trauma-related intrusive thoughts, nightmares, flashbacks, reactivity to (and avoidance of) trauma-related cues, numbing and detachment, sense of foreshortened future, concentration difficulties, hypervigilance, exaggerated startle, or sleep difficulties that are thought to comprise the essence of PTSD. These distinctions support our examination of the separate effects of PTSD and negative emotionality on substance-related problems in this study.

Table 1
Descriptive Statistics and Internal Consistency Reliabilities for Manifest Indicators

Manifest indicator	Items (no.)	*M*	*SD*	Min	Max	α
PTSD (all items; α = .92)						
Reexperiencing	5	9.85	3.50	4	15	.81
Avoidance	2	4.06	1.67	0	6	.69
Numbing	5	10.29	3.43	4	15	.80
Hyperarousal	5	10.74	3.52	4	15	.83
Disconstraint (all items; α = .73)						
Non-traditionalism	8	4.96	1.76	0	8	.50
Delinquency	5	1.92	1.57	0	5	.70
Impulsivity	6	3.24	1.50	0	6	.48
Negative emotionality (all items; α = .90)						
Anger	12	6.74	3.19	0	12	.84
Worry	11	4.68	2.36	0	11	.70
Anxiety	5	2.98	1.56	0	5	.66
Regret	5	2.18	1.16	0	5	.64
Alcohol problems (all items; α = .87)						
Self-reported problems	2	0.57	0.77	0	2	.68
Other indicators	3	1.01	1.22	0	3	.84
Frequency × Quantity	1	71.49	179.99	0	1500	—
Drug problems (all items; α = .86)						
Self-reported problems	2	0.30	0.63	0	2	.72
Other indicators	2	0.30	0.69	0	2	.93

Note. Overall alpha for alcohol problems excludes the Frequency × Quantity variable. Min = minimum; Max = maximum; PTSD = posttraumatic stress disorder.

physiological responses or entail undue risk for the participant, or (c) refused to refrain from the use of alcoholic beverages and illicit drugs for 24 hr prior to the evaluation as verified by urine toxicology.

2,115 individuals were screened for the study. Of these 1,461 qualified for eligibility and 1,266 completed the Minnesota Multiphasic Personality Inventory–2 (MMPI–2; Butcher et al., 1990). Following the recommendations of Arbisi and Ben-Porath (1995), and procedures used in our prior work (Miller et al., 2003, 2004), 168 cases with validity indices exceeding the following criteria were eliminated from the sample: $F > 100$ and $F(p) > 80$, or variable response inconsistency (VRIN) > 80, or true response inconsistency (TRIN) > 100 (all T scores).[2] A total of 96 additional cases were eliminated from analyses because of missing data on other measures of interest. Thus, the final sample was composed of 1,002 male Vietnam veterans: 701 (70%) identified themselves as Caucasian/White; 181 (18%) as African American/Black; 79 (8%) as Hispanic; 20 (2%) were American Indian/Alaskan Native; and 19 (2%) as Asian/Pacific Islander. The average age of participants at the time of the assessment was 43.37 years (SD = 3.98 years). The average education was 14 years (SD = 2.5 years) and annual income was $18,279 ($SD$ = $28,047). Of the participants, 51% were currently married. With regard to branch of service in the military, 623 (62%) reported serving in the Army; 230 (23%) in the Marines; 85 (9%) in the Navy; and 61 (6%) in the Air Force. Participants served an average of 14 months in Vietnam. Finally, 551 (55%) of the men met criteria for current PTSD secondary to combat, according to the Structured Clinical Interview for *DSM–IV* (SCID; Spitzer, Williams, Gibbon, & First, 1989), and 38% reported having a service-connected disability.

Measures

Table 1 presents descriptive statistics and reliability estimates for all manifest indicators of the variables examined in this study.

PTSD. PTSD severity was assessed with the PTSD module of the SCID (Spitzer et al., 1989). All diagnostic interviews were audiotaped. Diagnostic interrater reliability was assessed via review of 128 of the audiotapes by a second clinician and reassessment of 36 participants by a second clinician. Kappa, computed using the combined results of the two approaches, was .65 for the current PTSD diagnosis (see Keane et al., 1998). Dimensional scores (i.e., symptom counts) were not available for interrater reliability analysis. The internal consistency reliability for the SCID PTSD items was .92.

Disconstraint and negative emotionality. Disconstraint and negative emotionality was assessed using items from scales of the same name from the PSY–5 (Harkness et al., 1995, 2002). Unlike most MMPI–2 scales that were constructed using the empirical group contrast method and have overlapping and heterogeneous items, the PSY–5 scales were developed through a process designed to maximize the homogeneity and face validity of items within a scale, the correspondence between the items and the underlying construct, and the discriminant validity of the scales. Published internal consistency values for these scales based on data from clinical samples are good, with alphas ranging from .86 to .88 for Negative Emotionality and .68 to .75 for Disconstraint. Internal consistency values for the current study are listed in Table 1.

Prior evidence for the validity of the PSY–5 scales comes from multiple sources. Harkness et al. (1995) reported correlations between the PSY–5 Negative Emotionality and Disconstraint scales and the corresponding scales of the Multidimensional Personality Questionnaire (MPQ) of .72, and .57, respectively, in a large college student sample. Performing the same comparison, Miller et al. (2003) found correlations of .54 and .49 in a VA PTSD clinic sample. Similarly, Trull, Useda, Costa, and McCrae (1995) found correlations of .60 and .67 between the PSY–5 Negative Emotionality scale and the Neuroticism scale of the NEO Personality

[2] For readers less familiar with the MMPI–2, the F and $F(p)$ scales contain items that are infrequently endorsed by normative and inpatient samples, respectively, and are thought to be sensitive to the overreporting of psychopathology. VRIN and TRIN consist of pairs of items that have similar or opposite content and measure the consistency of item endorsement. These cut-offs were intended to exclude cases whose profiles indicated that they were either exaggerating their difficulties or responding to items in an unreliable manner.

Inventory (NEO–PI; Costa & McCrae, 1985) in community and clinical samples, respectively. Disconstraint, on the other hand, showed negative correlations (on the order of .3) with the NEO–PI Conscientiousness and Agreeableness scales in both samples. Scores on the PSY–5 Disconstraint scale have also been reported to be significantly correlated with indices of criminal behavior, including recent and lifetime alcohol and drug use, in a large outpatient community mental health clinic (Harkness et al., 2002). Finally, in the same sample, scores on Negative Emotionality were most highly correlated with Symptom Checklist 90-Revised (SCL-90-R; Derogatis, 1983) scales assessing an array of clinical symptoms including anxiety, hostility, interpersonal sensitivity, and depression, underscoring its ubiquitous role in most psychopathology.

Alcohol problems. A composite measure of alcohol problem severity was constructed from items assessing the quantity and frequency of alcohol use and related problems in the War Stress Interview (WSI; Rosenheck & Fontana, 1989) and the CAGE questionnaire (Bush, Shaw, Cleary, Delbanco, & Aronson, 1987). Alcohol quantity was defined as the sum of the number of drinks (across three categories: wine, beer, or hard liquor) that was usually consumed in one day during the past 30 days. Alcohol frequency was defined as the number of days of any alcohol use in the past 30 days. A combined alcohol use variable was created by multiplying alcohol quantity by alcohol frequency. Items assessing the extent to which the veteran perceived that he had a problem with alcohol included Do you think that you have a current problem with alcohol abuse/dependency? and Have you had a problem with alcohol at least one day during the previous 30 days? Three items from the CAGE questionnaire (Bush et al., 1987) assessed additional indicators of a problem with alcohol: Have you felt you ought to cut down on your drinking?, Have you felt bad or guilty about your drinking?, and Have you had a drink first thing in the morning to steady your nerves or get rid of a hangover?

The internal consistency reliability for a composite of these five alcohol problem items was .87. A principal component analysis supported a one-factor solution for this rationally derived scale, with all factor loadings above .62 and eigenvalues below 1.00 for solutions involving two or more factors. This factor accounted for 66% of the variance in self-perceived and other indicators of alcohol problems. Evidence for criterion validity was provided by the finding that individuals with current diagnoses of alcohol abuse/dependence based on the SCID scored the highest on this measure ($M = 3.45$); individuals with former (lifetime) alcohol abuse/dependence scored somewhat lower ($M = 1.60$); and individuals with no such history scored the lowest ($M = .18$).

Drug problems. The severity of drug-related problems was assessed using four items from the WSI. Items assessing perceived drug problems included Do you think that you have a current problem with drug abuse/dependency? and Have you had a problem with drugs at least one day during the previous 30 days? Items assessing additional indicators of a problem included (for veterans who endorsed using any drugs) Do you find you need larger amounts of these drugs to get an effect, or that you can no longer get a high or get to sleep on the amount you use? and Do you have any emotional or psychological problems from using drugs, such as feeling crazy or paranoid or uninterested in things? For these last two items, veterans who did not report drug use received a score of 0.

The internal consistency reliability for this measure was .86. As with the Alcohol Problems scale, items were submitted to a principal component analysis. Results supported a one-factor solution, with all factor loadings above .60 and eigenvalues dropping below 1.00 for solutions involving two or more factors. This factor accounted for 70% of the variance in drug problem scores. Evidence for criterion validity was provided by the finding that individuals with current diagnoses of drug abuse/dependence based on the SCID scored the highest on this measure ($M = 2.32$), individuals with past drug abuse/dependence scored somewhat lower ($M = .76$), and individuals with no history of drug abuse scored the lowest ($M = .04$).

Statistical Analyses

Structural equation modeling procedures were used to test the three competing hypotheses that guided this study (see Figure 1). This methodology is especially useful for examining complex associations among multiple constructs. For all structural equation modeling analyses, matrices of covariances were submitted to the LISREL 8 program (Jöreskog & Sörbom, 1993), and maximum likelihood estimation was used. Covariances among residuals in the measurement model were always fixed at 0. When variables representing psychopathology are measured in mixed samples (i.e., samples that include participants with and without severe psychopathology), assumptions of multivariate normality are frequently violated. Thus, we used the Satorra–Bentler (Chou, Bentler, & Satorra, 1991) correction for chi-squares and standard errors of the parameter estimates.

A two-step modeling process was followed in accordance with recommendations in the literature (Anderson & Gerbing, 1988). For this process, a measurement model incorporating the latent variables and their manifest indicators was specified and evaluated on one portion of the data ($n = 501$). A series of structural models were then evaluated on this same subset of data and replicated on the remaining 501 participants.

Results

Measurement Model

The measurement model comprised five latent factors (PTSD, disconstraint, negative emotionality, alcohol problems, and drug problems) and their 16 manifest indicators. PTSD was represented by four parcels of items (reexperiencing, avoidance, numbing, and hyperarousal symptoms) on the basis of research supporting the distinction between the avoidance and numbing symptoms and a four factor model of PTSD symptomatology (for a review, see Asmundson, Stapleton, & Taylor, 2004). For disconstraint, selected items from the PSY–5 Disconstraint scale were grouped rationally to create three parcels: risk-taking/impulsivity, nontraditionalism, and delinquency/law-breaking.[3] The full set of items from the PSY–5 Negative Emotionality scale were also grouped rationally to create four parcels: anger, worry, anxiety, and regret. Alcohol problems were measured with three manifest indicators derived from the WSI: alcohol use (represented by frequency multiplied by quantity), self-perceived alcohol problems, and additional indicators of an alcohol problem. Drug problems were measured with two indicators: self-perceived drug problems and additional indicators of a drug problem (no comparable measure of drug use frequency and quantity was available for analysis). Average item scores were used to represent manifest indicators. Descriptive statistics and internal consistency reliabilities for all manifest indicators are included in Table 1 and a matrix of bivariate correlations between all manifest and latent variables (based on the final model) is provided in Table 2.[4]

[3] An initial attempt at partitioning the full PSY–5 Disconstraint scale into three parcels yielded poor reliabilities for individual parcels so we eliminated 10 items that showed low item-total correlations. The eliminated MMPI items were 34, 88, 126, 154, 222, 263, 309, 385, 402, and 497. The correlation between the revised and original Disconstraint scales was .91.

[4] The correlation between the latent variables for PTSD and Negative Emotionality was .70. Correlations of this magnitude fall below widely

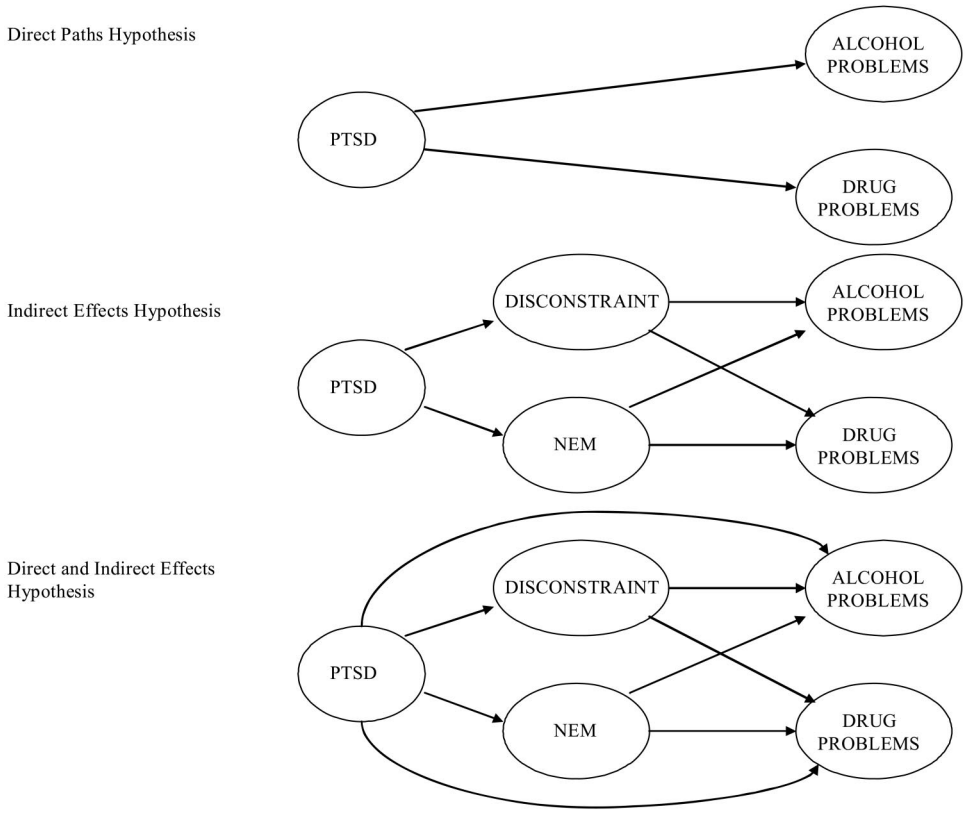

Figure 1. Schematic diagram depicting the three competing hypotheses. PTSD = posttraumatic stress disorder; NEM = negative emotionality.

Manifest indicators were specified to load on designated latent variables and the model was fit to the data. As indicated by the fit indices reported in Table 3, the resulting measurement model provided excellent fit to the data. Of particular note were the findings that the root mean square error of approximation (RMSEA) for this model exceeded the well-recognized .05 standard of close fit (Browne & Cudeck, 1993; Hu & Bentler, 1998; Steiger, 1990), and both the robust comparative fit index (CFI) and Steiger's (1990) corrected form of the goodness-of-fit index (GFI; Jöreskog & Sörbom, 1993) were larger than the recommended minimum values of .90 (Byrne, 1994) and .95 (Bentler, 1990), respectively.

accepted thresholds for both multicollinearity and poor discriminant validity (Kline, 2005). This amount of overlap suggests that the two latent variables share approximately 50% of their variance, leaving the other half of the variance in each unaccounted for by the other. This association is consistent with relationships found previously for other emotional disorders (e.g., T. A. Brown, Chorpita, & Barlow, 1998), and in line with evidence and conceptual models suggesting that negative emotionality is the unifying construct for these conditions (e.g., Watson et al., 2005).

We also examined bivariate manifest correlations between the PSY–5 scales not included in this study (Aggressiveness [AGGR], Introversion/Low Positive Emotionality [INTR], Psychoticism [PSYC]) and composite indices of PTSD, alcohol problems, and drug problems. The correlation coefficients were as follows: with PTSD: AGGR (.26), INTR (.52), PSYC (.48); with alcohol problems: AGGR (.12), INTR (.07), PSYC (.16); with drug problems: AGGR (.14), INTR (.03), PSYC (.17).

Structural Model

We next examined relationships among the five latent variables by evaluating a series of models that permitted tests of our three competing hypotheses. Results are reported in Table 3. We first specified a fully saturated model that incorporated all of the possible direct and indirect effects of PTSD on substance-related problems (the direct and indirect effects hypothesis). This model was used as a base model for comparison with the nested models specified below in which direct and indirect paths were removed. Our second model tested the impact of removing the direct effects from the fully saturated model (i.e., paths from PTSD to alcohol problems and drug problems; the indirect effects hypothesis). As indicated in Table 3, values of RMSEA, robust CFI, Akaike information criterion (AIC; Akaike, 1987), consistent Akaike information criterion (CAIC; Bozdogan, 1987), and Steiger's corrected form of the GFI for this model were highly similar to the first. Although these results might suggest that the two models provided equally good fit to the data, three findings point to the superiority of the second model, in which the direct effects were removed. First, results of the chi-square difference test computed using Satorra's (2000) formula for comparing models that involve the application of the Satorra-Bentler (Chou et al., 1991) correction indicated that fit was not significantly damaged by removing the direct effect paths, $\Delta S\text{-}B\chi 2$ (2, $n = 501$) = .34, $p > .05$. Second, the critical ratio corresponding to both of the direct effects in the first, fully saturated model did not meet criteria for signif-

Table 2
Bivariate Correlations Among Latent and Manifest Variables

Variable	1	2	3	4	5
1. PTSD	—	.22	.70	.20	.08
2. Disconstraint	.18	—	.44	.39	.34
3. Negative emotionality	.58	.37	—	.32	.15
4. Alcohol problems	.19	.31	.29	—	.38
5. Drug problems	.12	.24	.17	.31	—

Note. $n = 501$. Correlations among latent variables are above the diagonal; correlations among manifest variables are below the diagonal. All correlations were significant at $p < .05$. With the exception of alcohol problems, scores for manifest variables were derived by summing items across all parcels; for alcohol problems, scores on the three indicators were standardized and summed. PTSD = posttraumatic stress disorder.

icance ($T < 2.00$; Jöreskog & Sörbom, 1993). Third, the second model is more parsimonious than the first, and all other things being equal, a more parsimonious model is preferred (Jöreskog & Sörbom, 1993).

We then conducted an analogous examination of the impact of removing the four indirect paths from the first, fully saturated model (i.e., all paths to alcohol and drug use via negative emotionality and disconstraint; the direct paths hypothesis). This third model demonstrated poorer fit to the data relative to the second one, as indicated by higher values for RMSEA, AIC, and CAIC. Furthermore, the results of a chi-square difference test revealed that removing the indirect effects significantly damaged model fit relative to the fully saturated model, ΔS-Bχ2 (4, $n = 501$) = 17.59, $p < .05$.

Additional evidence for the superiority of the indirect effects model was provided by the cross-validation results. When selecting from among a series of nested models, better models have smaller cross-validation values across samples (Cudeck & Browne, 1983). Values for the cross validation from the first dataset to the second solution and vise versa were smallest for the model in which direct paths were deleted, larger for the model that specified both direct and indirect effects, and largest for the model in which indirect paths were deleted.

On the basis of the preponderance of support for retaining indirect paths, as well as evidence against the inclusion of direct paths, we proceeded with model simplification using the model that specified only indirect paths from PTSD to substance-related outcomes via disconstraint and negative affectivity (i.e., the model in which direct paths were deleted). Examination of path coefficients in this model suggested a respecification with the deletion of the path from negative emotionality to drug use. The critical ratio T value associated with this path was not significant, as indicated by a value below the recommended minimum of 2.00 (Jöreskog & Sörbom, 1993). Examination of the chi-square difference between this model and the previous model revealed that removing this path did not significantly damage fit, ΔS-Bχ2 (1, $N = 501$) = .15, $p > .05$. Moreover, examination of the chi-square difference between this model and the base model (the fully saturated model) revealed no significant damage in fit, ΔS-Bχ2 (3, $N = 501$) = 1.37, $p > .05$. This model is depicted in Figure 2. Examination of the fit indices revealed that this final model provided good fit to the data. Of particular note is the finding that the RMSEA for this model exceeded the well-recognized .05 standard of close fit (Browne & Cudeck, 1993; Hu & Bentler, 1998; Steiger, 1990), and the robust CFI was larger than the recommended minimum value of .90 (Byrne, 1994). Finally, examination of the unstandardized coefficients associated with the indirect effects of PTSD on both alcohol problems and drug problems provided additional support for this model: Both of these coefficients (B = .05, $T = 5.31$; B = .01, $T = 3.15$, respectively) had corresponding critical ratios that met criteria for significance (Jöreskog & Sörbom, 1993), suggesting that the effect of PTSD on substance-related problems is mediated through disconstraint and negative emotionality.

Discussion

The primary goal of this study was to test three competing hypotheses for the associations between PTSD, the personality dimensions disconstraint and negative emotionality, and substance-related problems. The first model specified direct paths from PTSD to alcohol and drug problems and was based on the concept that individuals with the disorder use substances to reduce their PTSD-specific symptoms. The second model posited that the association between PTSD and substance-related problems is fully mediated by the personality dimensions disconstraint and negative emotionality and included paths that passed from PTSD to the substance-related outcomes through the personality variables. The third model proposed that disconstraint and negative emotionality partially mediate the association between PTSD and substance problems and predicted (a) direct paths from PTSD to the two substance use outcomes and (b) indirect paths from PTSD through disconstraint and negative emotionality to these outcomes. Results

Table 3
Model Testing Sequence and Goodness-of-Fit Indices

Cross-validation model	χ^2	S-Bχ^2	p	df	RMSEA	SRMR	CFI	AIC	CAIC	GFI	Cross-validation indices
Measurement model	190.38	108.93	.14	94	.018	.04	.99	192.93	412.02	.99	.71/.62
Direct and indirect effects	190.38	115.62	.07	94	.021	.04	.99	199.62	418.72	.99	.71/.62
No direct effects	191.07	121.73	.04	96	.023	.04	.99	201.73	410.39	.99	.69/.57
No indirect effects	250.82	145.55	.00	98	.031	.07	.99	221.55	419.78	.99	.84/.71
Final accepted model	192.38	117.24	.08	97	.020	.04	.99	195.24	398.68	.99	.70/.57

Note. S-Bχ^2 = Satorra-Bentler chi-square; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual; CFI = robust comparative fit index; AIC = Akaike information criterion; CAIC = consistent Akaike information criterion; GFI = Steiger's corrected form of the goodness-of-fit index. The first value of the cross-validation indices represents the cross-validation of the model from the first dataset to the second solution; the second value represents the cross-validation from the second dataset to the first solution.

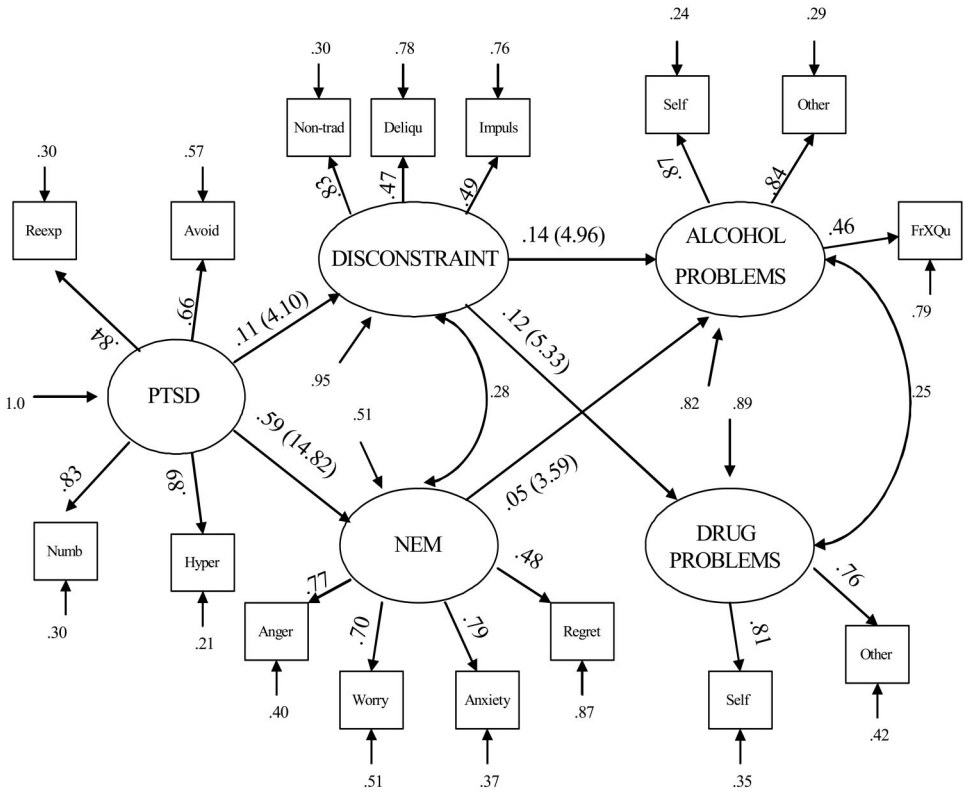

Figure 2. Final model incorporating both measurement and structural modeling results. Path coefficients are unstandardized and corresponding critical ratios are provided in parentheses. PTSD = posttraumatic stress disorder; NEM = negative emotionality; Reexp = reexperiencing; Avoid = avoidance; Numb = numbing; Hyper = hyperarousal; Non-trad = non-traditionalism; Deliqu = delinquency; Impuls = impulsivity; Self = self-reported problems; Other = other indicators; FrXQu = Frequency × Quantity.

supported the second hypothesis, with analyses suggesting that the best-fitting model of the data included (a) significant indirect paths from PTSD to both substance-related outcomes through disconstraint, (b) a significant indirect path from PTSD to alcohol problems through negative emotionality, but (c) no direct effects of PTSD on either substance-related outcome.

The finding that disconstraint was an important mediator of the association between PTSD and both drug and alcohol-related problems is novel in the context of the PTSD literature in which research on comorbid substance use has focused primarily on the PTSD self-medication hypothesis (operationalized here by the direct paths model; P. J. Brown & Wolfe, 1994; Ouimette & Brown, 2003; Stewart, 1996). Outside of the PTSD literature, however, the role of disconstraint in the development and maintenance of addictive behavior has been more clearly established (Caspi et al., 1996; Cloninger et al., 1988; Conway, Swendsen, Rounsaville, & Merikangas, 2002; Elkins, McGue, Malone, & Iacono, 2004; McGue et al., 1999) and a growing body of research has implicated this factor as the primary personality substrate for the broader externalizing spectrum of psychopathology.

Externalizing has been conceptualized as a latent dimension of psychopathology that accounts for the high rate of co-occurrence between antisocial personality disorder and the substance-related disorders in adults (Krueger et al., 2001, 2002), and conduct disorder, oppositional defiant disorder, and attention-deficit/hyperactivity disorder in children and adolescents (Achenbach & Edelbrock, 1978, 1984). In PTSD, where there is extensive heterogeneity in diagnostic comorbidity (T. A. Brown et al., 2001), individual differences in the manifestation of externalizing psychopathology are evident as well. In a series of recent studies of individuals with posttraumatic psychopathology, Miller and colleagues (2003, 2004; Miller & Resick, in press) provided evidence for an externalizing subtype characterized by high scores on measures of disconstraint and marked propensities toward antisociality, hyperactivity, anger, and substance abuse. Thus, the results of the present study add to a growing body of research suggesting that disconstraint may play a role in the development of externalizing behaviors accompanying PTSD. They also provide evidence supporting a link between disconstraint and both alcohol- and drug-related problems. Future studies using longitudinal designs might provide more substantive support for this linkage.

A different pattern was observed for negative emotionality with results suggesting that the disposition to experience frequent and intense negative affective states mediates the link between PTSD and alcohol-related problems, but not drug problems. This finding replicates prior evidence indicating that disconstraint and negative emotionality have differential associations with alcohol use versus drug use. Specifically, Chassin, Flora, and King (2004) examined

the developmental trajectory of alcohol and illegal drug use and dependence from adolescence through early adulthood and showed that whereas disconstraint and negative emotionality were both predictive of the development of substance-related disorders over this interval, there was a stronger link between disconstraint and drug dependence than between disconstraint and alcohol dependence. Negative emotionality, on the other hand, differentiated alcohol dependent from nondependent participants. Along the same lines, McGue et al. (1999) showed that personality differences between alcoholic and nonalcoholic individuals were evident primarily on measures of negative emotionality, whereas differences between individuals with and without a drug use disorder were found primarily on measures of disconstraint. More recently, the same research group demonstrated that the personality profiles of offspring of parents with substance use disorders showed diagnostic specificity, with negative emotionality associated with parental alcoholism and disconstraint with parental drug use (Elkins et al., 2004).

The finding in this study of associations between disconstraint and both drug and alcohol problems, and between negative emotionality and alcohol problems only, suggests the presence of distinct pathways to these substance-related problems in PTSD. The first pathway—via disconstraint—resembles the processes implicit in Cloninger's (1987) Type II alcoholism. In this condition, problems stem from propensities toward sensation-seeking and risky and/or uninhibited behavior, and may reflect enjoyment of the states of disinhibition that drugs and alcohol produce. The second pathway—via negative emotionality—resembles the processes implicit in Cloninger's Type I alcoholism. In this condition, alcohol is used in the service of avoiding, dampening, or escaping negative affective states. This is analogous to the PTSD self-medication hypothesis, which is not supported by the results of this study because there was no evidence for direct paths from PTSD symptoms to substance-related problems. Instead, our results suggest that the generalized heightened negative emotionality that follows in the wake of trauma and accompanies PTSD (Miller, 2003, 2004) accounts for more of the variance in alcohol problems than the specific symptoms listed in the *DSM–IV* definition of the disorder.

The indirect hypothesis we tested posits that PTSD causes negative emotionality and disconstraint. This hypothesis may seem to contradict the assertion of some trait theorists that external events do not influence basic dispositions (McCrae & Costa, 1995). It also seems to diverge from, although is not necessarily incompatible with, temperament-based models positing that negative emotionality and disconstraint play causal roles in the development of internalizing and externalizing disorders, respectively (e.g., Clark & Watson, 1991; Krueger et al., 2002). Our view is that negative emotionality represents the primary personality vulnerability factor for the development of PTSD and that both negative emotionality and disconstraint become accentuated as a consequence of the development of PTSD. This view is based on two basic tenets: Adaptive personality functioning involves the inhibition of pathological behavioral tendencies, including dispositions toward negative emotionality and disconstrained behavior, and PTSD compromises these self-regulatory processes resulting in the accentuation of pathogenic traits relative to premorbid levels (cf. Miller, 2003).

Similar propositions were advanced previously by other theorists. For example, Eberly, Harkness, and Engdahl (1991) hypothesized that "the experience of severe, life threatening trauma can shift the survivor along the curve of individual differences from an initial premorbid level [of negative emotionality] to a new higher level" (p. 369). Similarly, Clark, Watson, and Mineka (1994) suggested that the experience of anxiety or mood disturbance may cause permanent and/or transient alterations in the structure of personality, a proposition that they termed the *scar hypothesis.* Caspi and Bem (1990) also suggested that dispositional tendencies such as negative emotionality and disconstraint tend to be augmented during periods of heightened stress and significant life adjustment. Finally, Allport, Bruner, and Jandorf (1941) observed that catastrophic events tend to operate on individuals by accentuating tendencies evident in their premorbid functioning. These arguments are supported by the results of numerous cross-sectional studies showing that the personality profiles of individuals with PTSD deviate from community norms or control groups in psychopathological directions (including elevated negative emotionality and disconstraint; for reviews of this literature see, Miller, 2003, 2004), and data suggesting that scores on personality measures covary with the onset and remission of other Axis I conditions (Hirschfeld et al., 1989; Reich, Noyes, Coryell, & O'Gorman, 1986). Future studies should examine the proposition that negative emotionality and disconstraint become accentuated as a consequence of the development of PTSD using prospective longitudinal designs incorporating the assessment of personality and psychopathology pre- and posttrauma exposure, and/or behavioral genetics designs that would permit examination of the degree of similarity among identical twins discordant for trauma exposure on measures of personality and psychiatric symptomatology (e.g., the Vietnam Era Twin Registry; Eisen, True, Goldberg, Henderson, & Robinette, 1987).

The primary limitation of this study is the cross-sectional study design. Although structural equation modeling is a powerful technique for examining complex relationships among multiple variables simultaneously, the directions of such relationships cannot be determined from our data. Our findings are consistent with a mediating role of personality in the link between PTSD and substance problems, but we cannot be sure that PTSD preceded changes in disconstraint and negative emotionality, and the directions of such associations can only be inferred in relation to theory and relevant prior evidence of causation. A second limitation of this study involved the psychometric properties of the PSY–5 Disconstraint scale. Published internal consistency values for this scale are modest (.68 to .75; Harkness et al., 1995, 2002) as was the alpha for a composite of the manifest indicators in this study (.72). The marginal factor loadings and reliabilities for the individual Disconstraint parcels underscore limitations of the dichotomous MMPI–2 item set for the assessment of this construct. A third limitation is that the sample consisted entirely of male Vietnam veterans, which raises questions as to whether similar relationships would be observed in other trauma-exposed samples such as mixed gender or female samples, or individuals with more recent trauma exposures. In addition, the exclusion of veterans who either were unwilling to abstain from drug or alcohol use for 24 hr before the assessment, taking medications with autonomic effects (e.g., beta blockers), or produced invalid MMPI–2 profiles likely reduced the overall level of psychopathology within the

sample. Indeed, as Keane et al. (1998) noted in the original publication from this dataset, participants with PTSD had somewhat lower scores on measures of psychiatric symptoms, more stable marital histories, and fewer comorbid diagnoses than in several prior studies of Vietnam veterans with PTSD. These sample limitations were arguably offset by its large size, which allowed us to test structural models on one half and replicate those results using the other half.

To conclude, this study represents an initial effort to clarify the mechanisms of the link between PTSD and substance-related problems and it provides new evidence regarding the potential role of disconstraint in mediating this association. The findings suggest that it may be useful to develop psychotherapeutic and pharmacologic interventions for comorbid PTSD and substance use disorders that target the disconstraint pathway as well as the traditionally targeted negative affective symptom reduction pathway. More generally, the findings of this study underscore the importance of including measures of personality in examining associations between PTSD and comorbid disorders and other aspects of the structure of posttraumatic psychopathology.

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